The Maryland Fruit Grower

July, 1934

Maryland State
Horticultural Society

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The Maryland Fruit Grower

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COVER CROPS

Much has been written about cover crops and there is still plenty to be known about the question. At present we have several crops which are proving of value in Maryland orchards and other crops that offer promise. Some of the older crops for fall or late summer seeding are: alfalfa, rye, vetch, wheat, and sweet clover.

Those suitable for spring or early summer seeding are: lespedeza, orchard grass, soy beans, cowpeas.

In the Sixty-third Annual Report of the Michigan State Horticultural Society, Mr. Walter Toenjes reported on a comparison of soil management methods in a *young* orchard, which is interesting, since it concerns mulching and costs of various systems of culture. The article follows:—

"Fruit growers frequently ask the question as to whether or not apple trees should be grown under the clean culture or sod mulch system of management here in Michigan. In view of the fact that there are several factors which should be considered before either system is employed, this question can not be decided in a general way, to meet the varying conditions in each individual orchard. Conditions in one orchard may be entirely different from those in another. In one case clean cultivation should be practiced, while in the other case the sod mulch system could profitably be employed. In fact sod may be necessary to prevent erosion on a sloping or hilly site. Also, a young and thrifty orchard growing on a comparatively deep fertile soil could be managed successfully under the sod system, while an older orchard lacking in vigor could perhaps be made more profitable if given clean cultivation. Furthermore, trees growing on shallow, thin, or infertile soil no doubt would be more profitable under clean culture. This would undoubtedly also hold true for trees showing evidence of competition due to close planting.

In addition to these factors we may then expect a different response from the trees growing under either sod or cultivation. It is generally conceded that trees under cultivation have better foliage and that they make a somewhat greater annual growth than the trees of the same variety and age under sod. Also that under normal conditions the yield is greater and the fruit grows larger on the cultivated trees, but that the fruit does not, generally speaking, attain the high color and finish as does the fruit from trees growing under the sod mulch system. These conditions, coupled with the comparative cost of maintaining an orchard, either under sod or cultivation, should be of some assistance to the grower in deciding which system of soil management may best fit in with his own particular fruit growing program.

The comparative difference in the cost of growing apple trees under these two systems is quite pronounced. In some cases the extra cost of clean cultivation may be justified in giving larger returns, whereas in other cases the results from the cultivated or sod orchard may practically be equal, considering the amount of profit received. In connection with this, I should like to

discuss in little more detail the results obtained by Messrs. H. D. Hootman and H. M. Wells on the cost of maintaining a young apple orchard under these two systems of soil management, for the first seven years after planting. Their data compare favorably with those secured by other investigators.

The young apple orchard under observation was set in the spring of 1919, on the grounds of the Graham Experiment Station near Grand Rapids, Michigan. The varieties consisted of Duchess, Grimes, Baldwin, Stayman, Northern Spy, and Rhode Island Greening planted twenty feet apart each way in a clay loam soil. Corn was grown between the tree rows until the cover crop of rye was seeded about the middle of July.

In the spring of 1920 the orchard was divided into five plots, which received different soil treatments, as follows:

Plot 1—Clean cultivation with cover crop.

Plot 2—Clover—straw mulch. All hay removed from the plot. Straw applied as a mulch around the trees.

Plot 3—Alfalfa—straw mulch. All hay removed from the plot. Straw applied as a mulch around the trees.

Plot 4—Alfalfa—alfalfa mulch. One cutting removed from the plot. The balance used as a mulch around the trees.

Plot 5—Alfalfa—alfalfa mulch — fertilizer. Same as Plot 4 with an application of nitrate of soda each spring.

The maintenance cost for each plot was kept during the duration of the experiment. No charges were made against the plots for land rental, supervision, pruning, spraying, or harvesting. Man labor was calculated at $.30 per hour, while $.60 per hour was allowed for a man and team. The hay crops removed from the various sod plots was valued at $12.00 per ton.

Plot 1—was plowed each spring, followed by dragging every week or ten days until the middle of July when a cover crop of oats, rye, or rye and vetch was planted. For the seven year period the average annual cost of maintenance under this tillage, cover crop system was $10.58 per acre.

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Plot 2—was seeded to clover in 1920, but due to a poor stand it was reseeded in 1921. This seeding produced hay crops in 1922, 1923 and 1924. Since 1924 the clover was largely crowded out by blue grass which was cut once each season and allowed to remain on the ground. A heavy mulch of straw was placed around each tree at the beginning of the project and maintained by new applications whenever necessary. The value of the hay removed from this plot was deducted from the cost of maintenance for the seven year period, which leaves the average annual cost of $8.86 per acre for this clover—straw mulch system of management. During the two years that no additional straw was applied to the mulch the cost per acre was less than $1.00 per year.

Plot 3—was given the same treatment as Plot 2, except that alfalfa was seeded between the tree rows instead of clover. All of the alfalfa was removed from the plot for hay. Due to the fact that fair cutting of alfalfa were still being secured at the termination of the experiment in this plot the net returns were larger which, consequently, resulted in a net annual profit of $5.94 per acre.

Plot 4—was seeded to alfalfa the same as was Plot 3. In this plot, however, only one cutting of alfalfa was removed for hay, the balance being raked up and spread around the trees as a mulch. The use of the alfalfa for a mulch eliminated the purchasing of straw for this purpose which in turn reduced the maintenance cost for this plot. The average annual net profit, over and above the cost of maintenance was $6.68 per acre.

Plot 5—was given the same treatment as was Plot 4, excepting that an annual spring application of nitrate of soda was given each tree in addition to the mulch. In 1920 each tree in this plot received one-fourth pound of this fertilizer. These applications were gradually increased to five pounds per tree in 1926. The value of the hay removed from this plot practically equalled the cost of the fertilizer, consequently this system of maintenance showed neither profit nor loss.

Not only was the maintenance cost for each plot carefully kept, but the response of the trees to these various treatments was also recorded for the duration of the project. The general observations made show that the trees under cultivation were the best. The trees growing under the various types of sod mulch systems were variable in their response between treatments and they were smaller in tree spread, height, and trunk circumference than those growing under cultivation. Also the average yield and fruit sizes were smaller than those secured from the trees in the clean culture plot. However, since the differences in favor of the cultivated trees is not so large it did not justify the large expenditure of approximately $120.00 per acre, for the seven year period, to produce trees of this slightly greater growth and production. Therefore, the information gathered from the trees growing under the terms of this experiment justified the conclusion that where apple trees are grown on a comparatively fertile soil they can be brought up to the bearing age more economically by growing them under the sod system of management.

In connection with the foregoing experiment I would like to present some additional data taken during the year of 1931 on the original plots 1 and 2 of

that project. Please remember that these figures are not presented for the purpose of detracting from the value of the preceding project, but merely to give you something of interest and to show you what may happen in the best of regulated families. I will not attempt to offer any explanation for this behavior, since the figures obtained are contrary to the results secured by other investigators.

You will recall that the trees growing under cultivation in the preceding experiment were larger and produced more and larger fruit than the trees growing under the sod mulch system of management. This is generally accepted as the ultimate effect of cultivation in the apple orchard. However, this was not the case in these same two plots for the year of 1931. Instead, our results showed the very opposite to be true. Whether or not the extreme drouth condition for the years of 1930 and 1931 were responsible for this reverse condition is difficult to say.

Only four of the six varieties of apples in these plots will be taken into consideration at this time. These varieties are Duchess, Grimes, Baldwin, and Stayman. An equal number of trees of each variety were growing under the two different soil management systems, and excepting for this all trees in the two plots received the same treatment. Data on fruit sizes, terminal shoot growth, and soil moisture were taken. Taking under consideration first the comparative fruit sizes between the two plots and Duchess trees under cultivation yielded a total of 1732 pounds of fruit, 10 per cent of which were size A, while the same number of trees in sod yielded 2399 pounds of which 67 per cent were of A size. The Grimes trees in cultivation produced 2466 pounds which graded 32 per cent A, while the trees in sod yielded 3578 pounds, 81 per cent being A size. The cultivated Baldwin trees 1467 pounds of which 35 per cent fell into the A grade size, while the sod mulch trees produced 1268 pounds which graded out 91 per cent A size. The same condition held true for the Stayman variety, the cultivated trees bearing 1889 pounds grading 23 per cent A, and the trees growing in sod yielding 3557 pounds of which 79 per cent were of A grade size.

The average terminal shoot growth difference was not as pronounced between the plots as the fruit size records were. However, the difference in favor of the sod mulch trees is somewhat larger in spite of the fact that these trees produced a larger crop than the trees under cultivation. The growth for the cultivated trees taken collectively for the four varieties averaged 8.4 inches in 1931 whereas the trees under sod averaged 9.1 inches for that season. This difference was slightly greater between the cultivated and sod trees for the season of 1930, being 9.5 inches and 10.9 inches in favor of the trees in sod.

During the latter part of August of 1931 soil samples were taken in these same two plots to determine the amount of soil moisture to the depth of five feet. The per cent of moisture is based on dry soil and is not given as available moisture. The various samples taken from each plot were analyzed separately but the figures given here are a summary or average of all the samples taken under each plot treatment. For the cultivated plot the total moisture in the soil averaged 6.8 per cent, while in the sod plot the average soil moisture was 9.2 per cent. Taking into consideration the type of soil that these trees are growing on it is evident that a very small amount of the moisture present was available to the trees, indicating that the root system evidently was securing the necessary moisture from a greater depth than from

which the soil samples were taken. It was also interesting to note that the per cent of moisture in the first surface foot was extremely low, being 4.4 per cent for the cultivated plot, and 5.3 per cent for the sod plot, but below that to the depth of five feet the per cent of moisture did not vary more than 1.5 per cent between samples taken at one foot intervals. This was true in both the cultivated and sod plots.

These conditions were not only evident outwardly in our own orchard but they were also observed during 1931 in other orchards growing under similar conditions in the vicinity of Grand Rapids. Growers also have noticed the same differences in their own orchards and have frequently sought an explanation for this behavior. However, it is difficult at this time to offer any logical explanation for these differences, nor is it possible to make a flat footed recommendation, on the strength of these observations, in favor of the sod mulch system for apple orchards in Michigan. The acquisition of additional records in our orchards in the future may bring to light some additional information which will assist the apple grower in deciding upon what method to employ in his own orchard."

The Michigan results should apply rather closely to Maryland conditions. Another write-up which would apply to Western Maryland conditions is that of H. H. Hill, Associate Chemist at Blacksburg, (Va.) Agriculture Experiment Station who write in Virginia Extension Division News regarding methods of increasing the soluble nitrogen in the soil by use of green manures and mulches. He writes:—

"As a general rule, orchard soils of Virginia are very low in organic matter. This condition not only gives rise to low yields but to immense losses of valuable plant food through soil erosion. In certain sections of the state the washing away of plant food has depleted the soil to a much greater extent than the losses from crop removal. This organic matter must be replaced before profitable returns may be secured from the use of commercial fertilizers.

The importance of organic matter lies in the fact that it appears to be the chief agent concerned in the improvement of the water-holding capacity and the facilitating of tilth brought about by its incorporation with the soil.

The production of nitrate nitrogen is of obvious importance in the nutrition of plants and it is associated with interesting and complex chemical and biological changes. Nitrates are very earily lost from the soil through direct absorption by plants, by washing out or by decomposition; so any nitrogen transformed into nitrate may be regarded as potentially lost. No other nitrogen compounds, however, are liable to loss.

A soil left to the weather and devoid of all plant growth loses nitrogen fairly rapidly. The soil tanks at Blacksburg under such treatment, over a ten-year period, 1923 to 1932, lost from the first foot of soil 35 pounds of nitrate nitrogen per acre per year; from the second foot, 41 pounds, and from the third foot, 29 pounds. A winter cover crop not only conserves nitrogen but also prevents erosion. It reduces water loss, aids in giving the fruit plants proper maturity, and builds up the organic matter in the soil. Organic matter is directly concerned with the soluble nitrogen of the soil, and the two go hand in hand. It is estimated that two-thirds of a clover crop is removed at a cutting and one-third remains as stubble and roots, which may be turned under to aid in maintaining the supply of organic matter.

The importance of stable manure is well known and beneficial effects from its use are practically certain in most cases. The scarcity of this material is one of the present day problems, hence substitutes must be sought.

The green manures used as soil improvers may be divided into two classes, the legumes and non-legumes. Their efficiency depends upon the nitrogen-carbon ratio. The narrower this ratio between nitrogen and carbon, the greater the production of soluble or nitrate nitrogen when incorporated with the soil. To explain this ratio we might take rye, a crop extensively used for soil improvement. Rye cut April 1 is an entirely different substance chemically from rye cut at maturity on or about June 15. These dates are for Blacksburg and will vary in certain localities. The first cutting of this crop will give a high nitrogen percentage and a ratio of nitrogen to carbon of about 1 to 29. This is what would be considered a fairly narrow ratio. Rye cut at maturity contains very little nitrogen and a ratio of about 1 to 60. Rye cut April 1, when about six inches high, will decompose very rapidly when turned into the soil and give rise to abundant nitrate formation, while the mature rye in decomposing uses up the nitrogen generated by the fermenting material, together with that already present in the soil. The reason why the mature material causes this disappearance of nitrogen in its soluble form is that sugary substances, better known as carhohydrates, are developed as the plant matures. These substances furnish energy material to the soil bacteria which require nitrate to build up their cell substance, so as the plant materials break down, the nitrate is consumed. Wheat and rye straws when turned into the soil often cause injurious effects that take years to overcome. After these tough materials are broken down, nitrification will begin again.

Soil tank experiments now under way by the chemical department of the Virginia experiment station with green mature rye mulched and turned show abundant liberation of soluble nitrogen from the young rye, together with large amounts of calcium carbonate going out in the soil solution. The surface treatment of the green material liberates as much soluble nitrogen as the same amount incorporated with the soil. The mature rye shows a more or less depressing effect.

In the use of legumes the situation is entirely different. Clover, vetch and the lespedezas give a much narrower carbon-nitrogen ratio. The range of these substances is from 1 to 9 to 1 to 12. This narrow ratio is maintained throughout the life of the plant much better than with the non-legumes. When these materials are turned into the soil, nitrification begins immediately and continues to give large amounts of soluble nitrogen in the soil water over a long period. In some cases at Blacksburg the annual outgo of soluble nitrogen with red clover in soil tanks has been as high as 250 pounds of nitrogen the first four years after turning under. After this period the yearly outgo drops slightly.

To illustrate the disappearance of soluble nitrogen from the soil, we might take the example of apple pomace, or better still, decayed apples. When these materials are worked into the soil, the nitrate is lost almost immediately. These sugary bodies will take up nitrate almost as fast as it is added to the soil. This will continue until the last vestige of the pomace remains. This injurious effect cannot be overcome unless more nitrate than pomace is added. The reason why apple pomace and decayed apples are mentioned is to show how injurious it would be to allow waste and decayed apples to remain under trees

and be gradually worked into the soil.

Green manure crops should be turned under fairly early so that the land can settle and give the organic matter a chance to decay. The ideal time to turn rye under is when it is six to eight inches high and vetch and clover when they begin to bloom.

There is a lot of investigational work to be done on cover crops and mulches for orchards in their relation to surface nitrification. Get the organic matter on in some way and, provided the carbon-nitrogen ratio is not too wide, the nitrification question will take care of itself.

POLLINATION BULLETIN

"Self-and Cross-Pollination Studies of Apple Varieties, particularly Rome Beauty and Gallia Beauty", is the title of a paper by Dr. F. S. Howlett of Ohio Agricultural Experiment Station. This paper may be obtained for 5 cents a copy by writing Superintendent of Documents, Government Printing Office, Washington, D. C., asking for Reprint from Journal of Agricultural Research, Volume 47, No. 7.

The paper is interesting and valuable as it gives information on pollination of new, red strain of Rome Beauty. A summary of results follows:

"Rome Beauty and Gallia Beauty produced an appreciable number of fruits when selfed, but under the most favorable nutritional conditions only 25 to 50 percent of a full crop was produced.

Gallia Beauty and Rome Beauty were only partly effective as pollinizers of each other. Approximately the same percentages were obtained as when each variety was selfed.

Rome Beauty No. 73, supposedly a seedling of Rome Beauty, was also only partially compatible on Rome Beauty and Gallia Beauty. Stark's Dark Red Rome also was only partially effective as a pollinizer of Gallia Beauty.

McIntosh, Jonathan, Golden Delicious, Starking, and Red Spy were effective pollinizers of Rome Beauty and Gallia Beauty. Melba was effective as a pollinizer of Rome Beauty. No evidence was obtained indicating a difference in the effectiveness of these varieties as pollinizers of Rome Beauty and Gallia Beauty.

The failure of Grimes Golden to produce fruit on the Arkansas was confirmed.

Baldwin produced an appreciable set of fruit when selfed. Under favorable nutritional conditions self-fruitfulness was 25 to 50 percent of a full crop.

Delicious was self-unfruitful, and Starking failed to produce fruit when used as a pollinizer of this variety. The combination Delicious X Starking and its reciprocal, together with the Gallia Beauty-Rome Beauty relationship and its reciprocal, are apparently examples of an incompatibility similar to that found in other fruits, notably the sweet cherry.

Jonathan, Gallia Beauty, Cortland, and Golden Delicious were effective pollinizers of Delicious. No evidence was obtained indicating a difference in their value as pollinizers.

McIntosh had a low degree of self-fruitfulness.

Jonathan flowers showed a degress of self-fruitfulness equivalent to 25 to 50 percent of a full crop under the most favorable nutritional conditions. Be-

cause of their low pollen germinability, Minkler and Turley were ineffective pollinizers of Jonathan or any other variety on which they were used.

Turley, a variety of the Stayman Winesap type, had a corresponding low degree of self-fruitfulness. Delicious and Jonathan were effective pollinizers.

The varieties which consistently showed the highest degrees of self-fruitfulness during the course of the writer's experimental work over a period of 9 years are Baldwin, Jonathan, Rome Beauty, and Gallia Beauty. This self-fruitfulness, however, even under the most favorable nutritional conditions, has never been equivalent to a full crop."

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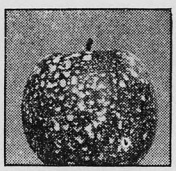

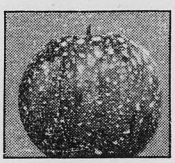

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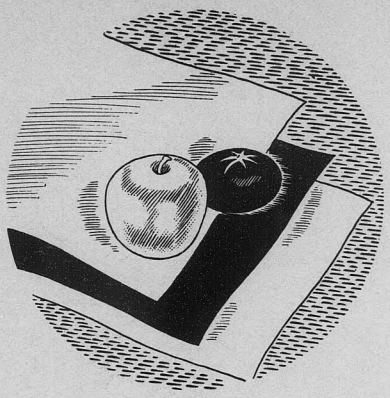

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